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P01/7700 0.00-0311852.8

Request for grant of a patent

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1.	Your reference	TJF/JY/39683
2.	Patent application number *(The Patent Office will fill in this part)*	0311852.8
3.	Full name, address and postcode of the or of each applicant *(underline all surnames)*	WESTWIND AIR BEARINGS LTD HOLTON ROAD HOLTON HEATH POOLE DORSET BJ16 6LN
	Patents ADP number *(if you know it)*	6348536001
	If the applicant is a corporate body, give the country/state of its incorporation	UNITED KINGDOM
4.	Title of the invention	ROTARY TOOL HOLDER ASSEMBLIES
5.	Name of your agent *(if you have one)*	fJ Cleveland
	"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	40-43 Chancery Lane London WC2A 1JQ
	Patents ADP number *(if you know it)*	07368855001
6.	If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number	Country / Priority application number *(if you know it)* / Date of filing *(day / month / year)*
7.	If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application	Number of earlier application / Date of filing *(day / month / year)*
8.	Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if: a) any applicant named in part 3 is not an inventor, or b) there is an inventor who is not named as an applicant, or c) any named applicant is a corporate body. See note (d))*	YES

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	-
Description	15
Claim (s)	-
Abstract	-
Drawing (s)	1 + 1

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10. If you are also filing any of the following, state how many against each item.

Priority documents	-
Translations of priority documents	-
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	-
Request for preliminary examination and search *(Patents Form 9/77)*	-
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	-

11. I/We request the grant of a patent on the basis of this application.

Signature FJ Cleveland
fJ Cleveland

Date
22 May 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr T J Faulkner 020 7405 5875

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Rotary Tool Holder Assemblies

This invention relates to rotary tool holder assemblies, particularly rotary tool holder assemblies used in the printed circuit board manufacturing industry.

Typically, rotary tool holder assemblies are used in the printed circuit board manufacturing industry for high speed drilling or high speed machining using router bits.

Such rotary tool holders need a simple and effective means for gripping the tool for operation because of the high speeds of rotation used.

Because a relatively large number of tools will be used over time, rotary tool holders, and especially their mechanism for clamping and releasing tools are susceptible to wear.

Conventionally greases are used on surfaces within rotary tool holders which are liable to wear.

Furthermore, in at least some types of rotary tool holders, very low friction sliding between moving components within the tool holder can be important for providing a sufficiently strong grip on an inserted tool to allow proper

operation. The provision of grease on the appropriate surfaces can at least initially provide the desired low friction between the sliding surfaces. However, if grease is lost or dries, the frictional forces will increase, impairing the performance of the rotary tool holder.

If the gripping force of a rotary tool holder reduces to the point where tool slippage occurs during use, damage can be caused to the tool holder assembly and the tool. Typically a rotary tool holder assembly will comprise a collet in which the drill shank is held and this collet is particularly susceptible to damage. Other components in the rotary tool holder assembly can suffer fretting damage to their surfaces.

Greasing is almost universally used at present but has disadvantages. Firstly, whilst grease may be applied to almost any surface during the original manufacture of the tool holder, the further application of grease as part of a servicing operation can be difficult or impossible. Furthermore, in the high speed drilling and machining operations with which this application is particularly concerned, grease can be driven out from its desired location due to centrifugal effects.

Therefore, over the life of a rotary tool holder its performance can be

significantly degraded due to wear and lack of lubrication.

It is an object of this invention to provide rotary tool holder assemblies which alleviate at least some of the problems associated with the prior art.

According to one aspect of the present invention there is provided a rotary tool holder assembly comprising a collet carried by a shaft, wherein the collet is moveable relative to the shaft between a tool gripping position in which an inserted tool can be gripped for rotation and a tool release position, and at least one surface of the assembly is coated with a friction reducing coating.

In this specification, a friction reducing coating is a coating which gives rise to a lower frictional force between relatively moving parts than would occur if the coating were not present.

The rotary tool holder will typically be arranged for high speed rotation, at say, in the region of 10,000 to 250,000 rpm. The tool to be gripped will typically be a drill bit or a router bit.

Preferably, at least one portion of the collet is coated with a friction reducing coating.

In one set of embodiments, the shaft comprises a bore for receiving the collet. At least part of an outer surface of the collet which faces the internal surface of the shaft bore may be coated with a friction reducing coating. Part or all of the internal surface of the shaft bore may be coated with a friction reducing coating.

The collet may comprise a plurality of jaw portions for gripping an inserted tool. Typical numbers of jaw portions are three, four, six or eight.

The collet and/or shaft may be tapered so that axial movement of the collet relative to the shaft causes or allows the jaw portions of the collet to move in a direction transverse to the axis of the collet for gripping and releasing of an inserted tool. Preferably the tapering is such as to force the jaw portions into gripping contact with an inserted tool under movement of the collet relative to the shaft in one direction and the collet is arranged so that the jaw portions are biased away from gripping contact, so that an inserted tool will tend to be released as the result of movement of the collet relative to the shaft in the opposite direction.

The taper surfaces of the collet and/or the shaft may be coated with a friction reducing coating. It is particularly prefered for some or all of the taper surface

of the collet to be coated with a friction reducing coating.

The collet will typically be generally cylindrical and substantially the whole of the outer curved surface of the cylinder may be coated with the friction reducing coating.

The shaft will typically be arranged to be journalled in a tooling machine. The surfaces of the shaft which are arranged to be received in the bearing(s) of the tooling machine may be coated with a friction reducing coating.

In one set of embodiments the collet may be carried by a bobbin arranged for axial movement within the bore of the shaft. The collet may be carried on the bobbin by virtue of being mounted on a stud retained within the bobbin. A guidebush insert may be provided within the bore of the shaft and the bobbin arranged for axial movement within the guide bush. Spring means may be provided for biasing the collet towards the gripping position. The spring means may be arranged for acting on the bobbin to bias the collet towards the gripping position. The spring means may be disposed in a spring receiving bore which may be provided in the shaft.

At least a portion of one of, or any combination of, the following components

may be coated with a friction reducing coating: the bobbin, the guide bush, the spring means, the spring receiving bore.

In one embodiment each surface of each component of the assembly that moves in contact with the surface of another assembly component during the insertion and/or release of a tool is coated with a friction reducing coating.

Preferably the internal surface of the collet, and especially the inner tool gripping surfaces of the jaw portions of the collet are kept free of friction reducing coating.

The coating preferably has a very low coefficient of friction, say in the region of 0.1 or lower.

Preferably the coating is applied to parts using a low temperature process to avoid changing the properties of the materials of the coated components. The process may be conducted at room temperature.

Preferably the coating is thin. More preferably still, the coating is sufficiently thin that the coating may be applied after the finishing processes have been carried out on the components and, after coating, the components remain within

the selected manufacturing tolerances.

Preferably the coating is applied evenly over the coated surfaces. This can ensure that the geometry of the components is maintained and there is no edge build up of coating material. The coating is preferably useable on heat treated materials without damage.

The coating is preferably compatible with at least one of, or any combination of: solvents, lubricating oils and greases.

The coating preferably has sufficient hardness to resist handling damage. The coating may have a hardness in the region of 30 Rc (Rockwell Hardness scale C).

According to another aspect of the present invention there is provided a collet for a rotary tool holder assembly, at least one portion of which collet is coated with a friction reducing coating.

According to another aspect of the present invention there is provided a method of manufacturing a rotary tool holder assembly comprising a collet carried by a shaft, wherein the collet is moveable relative to the shaft between a tool

gripping position in which an inserted tool can be gripped for rotation and a tool release position, the method comprising the steps of machining and finishing a plurality of component parts of the assembly within selected manufacturing tolerances and after the machining and finishing steps, applying a friction reducing coating to at least one portion of at least one of said components without causing the dimensions of the coated component to fall outside of the selected tolerances.

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a sectional view of part of a rotary tool holder assembly;

Figure 2 is a sectional view of a collet of the rotary tool holder assembly shown in Figure 1; and

Figure 3 is an isometric view of the collet shown in Figure 2.

Figure 1 shows a rotary tool holder assembly which comprises a shaft 1 which carries a collet 2 for holding a tool (not shown). The collet 2 is arranged for movement within the shaft 1 between a gripping position in which an inserted

tool is firmly gripped for rotation and a release position in which the tool may be relatively easily inserted into and removed from the collet 2.

The release position corresponds to the collet 2 projecting further out of the shaft 1 and the gripping position corresponds to the collet 2 being drawn back into the shaft 1. That is to say movement of the collet 2 towards the left in the orientation shown in Figure 1 will release the gripping force on an inserted tool, whereas movement to the right will increase the gripping force on an inserted tool.

As is perhaps most clearly seen in Figure 3, the collet 2 is of generally cylindrical shape and although not shown in the drawings the shaft 1 similarly has a generally cylindrical shape.

As best seen in Figure 3, the collet 2 in this embodiment comprises four jaw portions 2a which are arranged for gripping an inserted tool. Slots 2b terminating in stress relieving apertures 2c are provided in the body of the collet 2 to allow the jaw portions 2a to flex relative to the remainder of the collet 2. In other embodiments there may be differing numbers of jaws, for example there may be three, six or eight jaw portions.

A central portion of each jaw portion 2a carries an external taper which mates with an internal taper in a front portion 1a of the shaft 1. When the collet 2 is moved axially relative to the shaft 2 these tapers interact to cause the jaws 2a to move closer to one another, to grip an inserted tool, as the collet 2 is moved into the shaft 1 and similarly allow the jaw portions 2a to move away from one another, to release an inserted tool, as the collet 2 is moved further out of the shaft 1.

Rubber inserts 2d (not shown in Figure 3) are provided in each of the jaw portions 2a to bear on the internal taper of the front portion 1a of the shaft 1. These inserts provide a dust seal to prevent or limit the ingress of dust into the assembly via the slots 2b.

The body of the shaft 1 comprises a main bore which has two portions of different diameter. The first portion of the bore is adjacent to the front portion 1a of the shaft and has a diameter which is larger than the diameter of the second portion of the bore 1c which is disposed further into the body of the shaft 1.

The collet 2 is threadingly mounted on a threaded stud 3, which itself is retained in a bobbin 4 arranged for movement within the shaft 1. The collet 2

is threaded onto the stud 3 during assembly and is locked in position using a locking grub screw 5. Thus in normal operation the collet 2, stud 3 and bobbin 4 move together relative to the shaft 1.

The collet 2, stud 3 and bobbin 4 are housed within the second portion of the main bore 1c of the shaft 1. A guide bush insert 6 is provided within the bore of the shaft 1 and is arranged to guide the movement of the bobbin 4 and hence the collet 2.

The first part of the main bore 1b houses a set of springs 7 which act on a shoulder 4a of the bobbin. The springs 7 are put under compression during assembly so that the springs 7 tend to drive the bobbin 4 further into the shaft 1 so retracting the collet 2. As described above, due to the mating tapers of the collet 2 and front portion 1a of the shaft, retraction of the collet 2 causes the collet jaw portions 2a to grip an inserted tool.

Therefore, when a tool is to be inserted into the rotary tool holder, a push rod is used to push the bobbin 4, and hence collet 2, forward such that the jaw portions 2a of the collet may spread to allow the insertion of a tool. When the force of the push rod is removed, the collet 2 and bobbin 4 retract under force of the springs 7 into the shaft 1 causing the jaws 2a to close onto and grip the

inserted tool.

It will be noticed that during the movement of the bobbin 4, stud 3 and collet 2 relative to the shaft 1, there are various components which are in sliding contact with one another.

This has two implications. First of all these components are susceptible to wear and, secondly the frictional force between these sliding components must be kept to a minimum if a good gripping force is to be exerted on an inserted tool.

In the present embodiment, to give good wear characteristics and maximise the gripping force which is exerted on an inserted tool, components within the tool holder assembly are coated with a friction reducing coating.

In particular, the outer curved surfaces of the collet 2 are provided with a friction reducing coating.

Other surfaces in the tool holder assembly can also be coated with a friction reducing coating. These surfaces include: the internal curved surface of the guide bush insert 6; the taper surfaces of the front portion 1a of the shaft; the

outer cylindrical surface of the bobbin 4; the internal cylindrical surface of the first part of the main bore 1b which houses the springs 7; and the whole of the surfaces of the springs 7, or at least those parts which come into contact with the bobbin 4 and/or the internal cylindrical surface of the first part of the main bore 1b.

On the other hand however, the internal cylindrical surface of the collet 2 and especially the internal surface of the jaw portions 2a is kept clean of friction reducing coating to ensure that maximum grip is exerted on an inserted tool.

The provision of friction reducing coating on these components, and first foremost on the external curved surfaces of the collet 2, in particular the taper surfaces of the collet 2, can give rise to a very low maintenance product which will retain a high gripping force on an inserted tool over a long period of time without the need for any regreasing.

The friction reducing coating should have a low coefficient of friction, preferably a very low coefficient of friction of in the region of 0.1 or lower. It is preferred that the friction reducing coating can be applied to parts using a low temperature application process, for example a room temperature application process. This is to avoid changing the material properties or

conditions of the components during coating.

The coating is preferably thin, and in a preferred manufacturing process, the components are machined and finished to the desired size within chosen manufacturing tolerances and the friction reducing coating is then applied to the relevant surfaces of the components whilst staying within the manufacturing tolerances. Compared with the typical assembly tolerances (of say 2.5 microns on diameter) in devices of interest, the coating should be thin and say in the order of 0.5 microns or less.

The coating should follow the geometry of the existing machined surfaces and exhibit no edge build up.

The coating should be usable on heat treated materials without damage and, furthermore, should be compatible with solvents, lubricating oils and greases which may be used deliberately or may come into contact with the coated surfaces during assembly or use.

The coating needs to have a reasonable degree of hardness to resist handling damage. A hardness of 30 Rc (Rockwell hardness scale C) or greater is considered to be appropriate.

Although not shown in the drawings, the rotary tool holder assembly will be arranged to be received in a tooling machine for rotary drive. The shaft 1 therefore has journal surfaces to be received in appropriate rotary bearings and these journal surfaces can be coated with a friction reducing coating to give low friction starting and anti-scuffing where air bearings are used, and to generally assist with bearing lubrication where mechanical bearings are used.

1/1

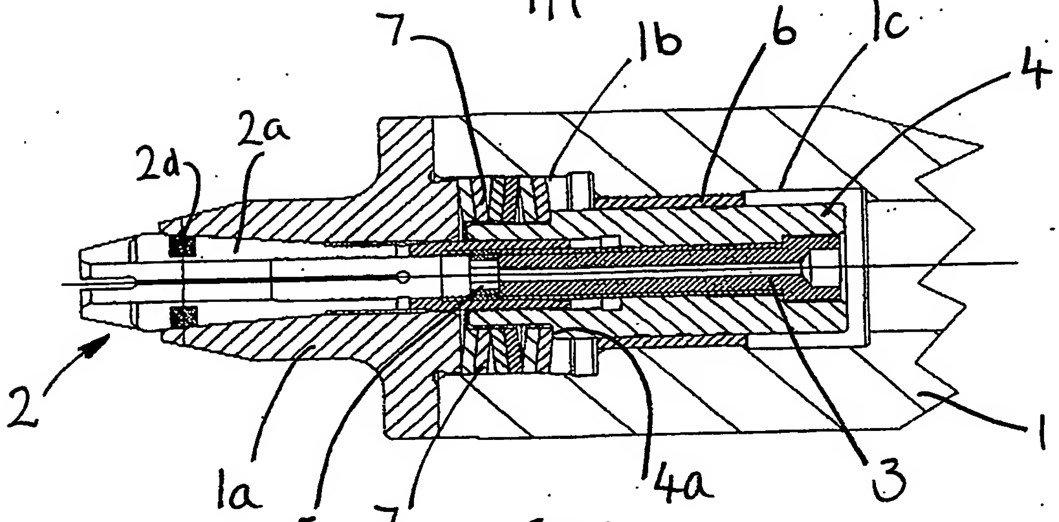

FIG.1

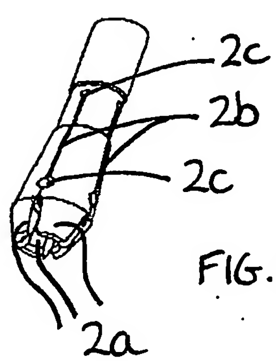

FIG.3

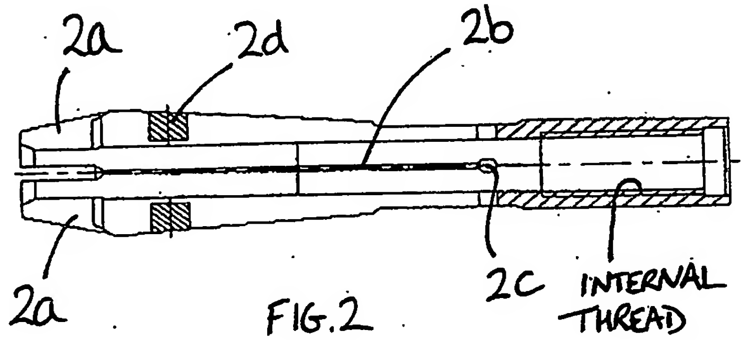

FIG.2